CHAPTER 5

CERTAIN CYCLIC HISTOLOGICAL CHANGES IN THE TESTIS OF THE MIGRATORY STARLING, STURNUS ROSEUS(LINNAEUS)

It is well known that the post-nuptial testis in migratory birds, is in a highly regressed state (Farner, 1955; Marshall, 1961), and may continue to remain so in the temperate zones indefinitely under short photoperiods. However, with increase in day length, the development of the testis starts and the body begins to accumulate fat (Odum and Perkinson, 1951; Wolfson, 1945, 1954; Kamemoto *et al*., 1958; Farner and Oksche, 1962; Naik, 1963).

Rowan's (1925, 1926) pioneering experiments demonstrated that under artificially increased day length, premature testis could be made to develop even in winter. That photostimulation could evoke testicular development has since been confirmed in many avian species by several workers (Burger, 1949; Miller, 1954; Farner, 1959). Marshall (1959) and Wolfson (1960) showed that the testis developed by longer photoperiodic stimulation could not be sustained indefinitely. Wolfson (1952, 1959a, 1959b) and several others (Winn, 1950; Farner, 1955; Farner and Oksche, 1962), demonstrated the accumulation of fat and gonadial development by increased daily photoperiod in migratory birds.

In equatorial birds light plays a minor role in gonadial stimulation (Disney and Marshall, 1956). In the refractory period of some trans-equatorial migrants the gonads were found to be non-responsive to light stimulation. Recently Disney *et al*., (1959) reported that in the equatorial bird, Quelea quelea, the gonads did not response to longer photoperiodic treatment. Later Engels (1961) showed that a trans-equatorial migrant responded to longer photoperiodic stimulation after having been subjected for some weeks to a shorter photoperiodic treatment, thus rendering it photosensitive.

Assenmacher (1957a, 1957b, 1958) studied in drakes, the role of hypothalamic neurosecretory cells in the gonadotropic function of the adenohypophysis, by means of lesions made in the lateral walls of the preoptic recess and the third ventricle. In the successfully operated drakes was seen rapid testicular regeneration resembling the condition that follows hypophysectomy or sectioning of the portal veins. Farner and Oksche (1962) reviewing the literature on neurosecretion in birds, have mentioned that with less extensive lesions abundance of neurosecretory material in the "Zone specialé" and in pars nervosa was obtained. Oksche et al., (1959) showed the effect of photoperiodism on the relation of the hypothalamic neurosecretion to testicular response in migratory birds.

The present investigation on certain histological and histochemical aspects of the testis in a migratory starling, Sturnus roseus has been carried out with a view to a better understanding of the relationship between the seasonal cyclic changes in the testis and the endocrine and neuroendocrine control discussed in other chapters (Chapters 4, 6, 7).

Material and Methods

The Rosy Pastors arrive in Baroda (India) from their breeding grounds abroad some times about September and leave by late April. Male birds were collected every month from October upto the end of April by shooting with an air rifle. Both the testes were removed and weighed. The histological observations on the testis obtained from birds captured on different days were fixed in Bouin's and in Zenker formol. Paraffin sections of the material were stained with iron haematoxylin and eosin. For fat staining the material was fixed in calcium formol and embedded in gelatin. The sections were taken on a freezing microtome and stained with Sudan Black B. The following measurements were made. (1) The diameter of the tubules (2) cell counts from tubules seen in transverse sections of the testis. The diameter of 25 seminiferous tubules were measured and their cells counted in each individual bird. The average of the figures obtained for 5 birds was taken into account (Table I).

Observations

October to January:

The testes were very small and the average weight of each testis was about 3.5 to 4.25 mg from October to January as shown in Table I. In all specimens studied the seminiferous tubules were very narrow and their diameter showed a gradual increase from 38.0 μ to 47.5 μ (Table I). The interstitial cells were found to be small having small nuclei and little fat. The seminiferous tubules consisted of only the spermatogonia in a single layer of cells. In each section of the tubule about 18 cells were present in the peripheral region leaving the central lumen empty. The spermatogonia were large containing a large nucleus and nucleolus without showing any meiosis (Fig.1). The interstitial cells as well as the cells of the seminiferous tubule contained little fat. The blood supply in the testicular tissue was also very meagre.

Table I showing the histological changes in the testes of Rosy Pastor during different months.

Months	Average wt. of testis (mg) *	Average diameter of tubule (µ) +	Average number of cells/tubule in section **
October	3.5	38.0	18
November	4.0	39.5	18
December	4.25	41.0	19
January	4.25	47.5	25
February	11.00	52.5	33
March	14.50	72.0	58
April (1-7)	25.00	98.0	112
April (8-26)	210.00	175.0	362

* Average weight of a testis calculated from the sum of the weights of the right and left testes of 10 male birds.

\+ Average diameter of seminiferous tubules measured from 125 cross sections of tubules from the testes of 5 birds.

** Average number of cells per tubule calculated from measurements made of 125 cross sections of seminiferous tubules from the testes of 5 birds.

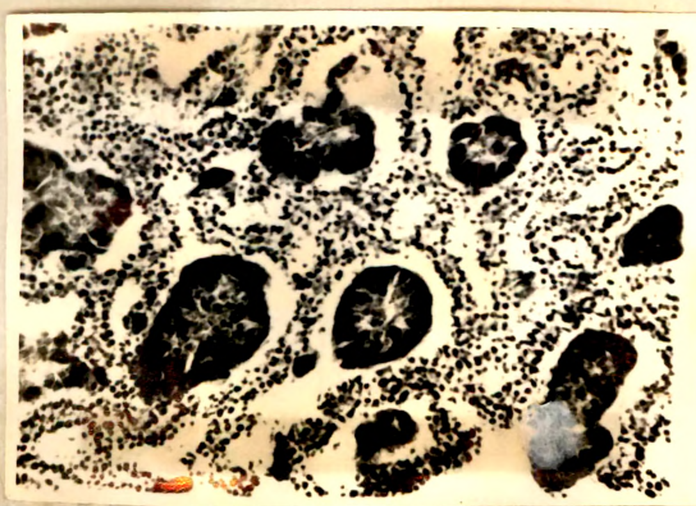


Fig. 1

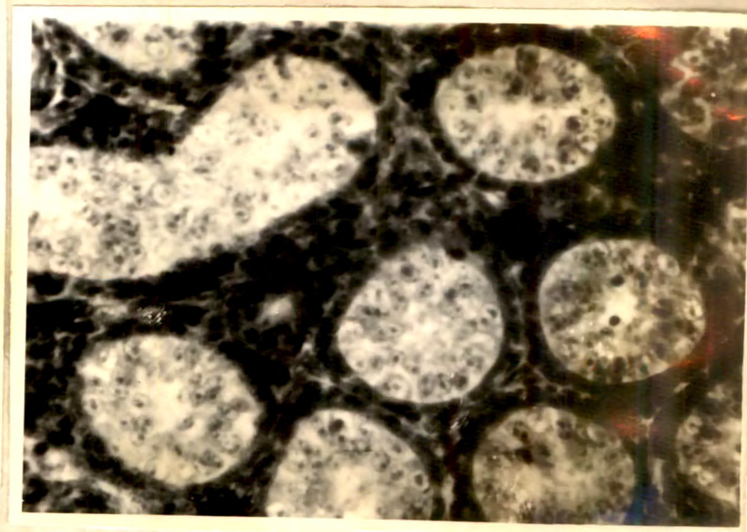


Fig.2

Fig. 1. Photomicrograph of T.S. of testis of Rosy Pastor in month of October showing the tubules in a regressed condition and the interstitial cells inactive. (Iron haematoxylin& eosin stained)

Fig. 2. T.S. of testis in the last week of February. The interstitial cells are more prominent. (Iron haematoxylin & eosin stained)

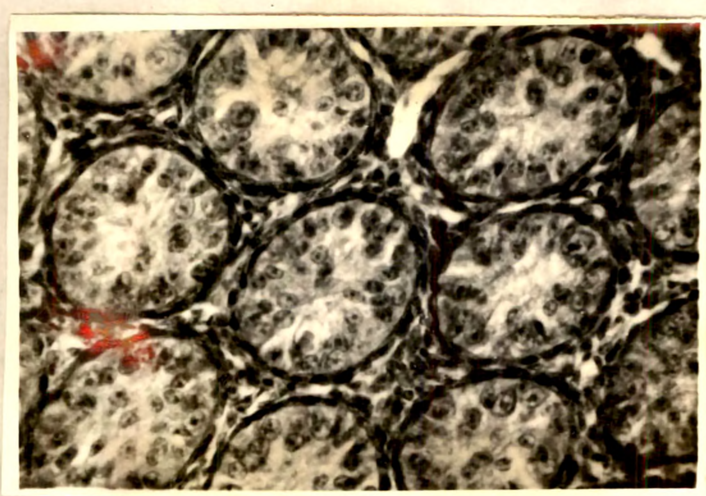


Fig. 3

50 μ

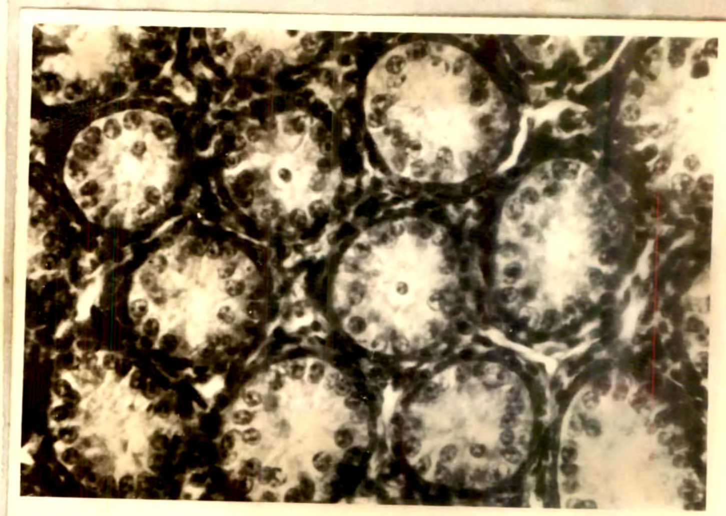


Fig. 4

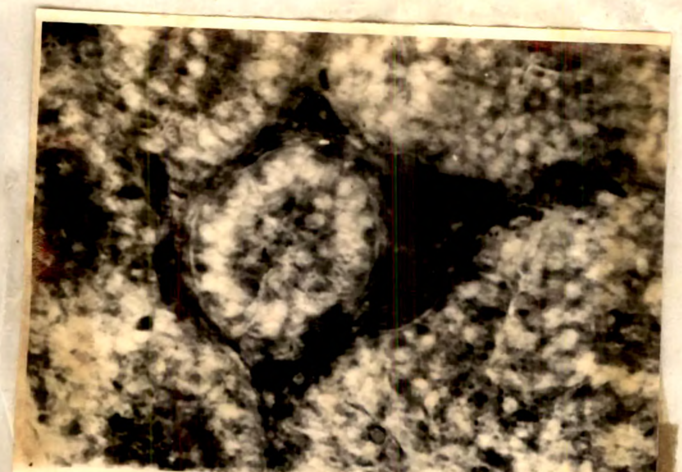
Fig. 3. T.S. of testis in the first week of March showing the emormous increase in the size as well as the number of the interstitial cells. (Iron haematoxylin & eosin stained)

Fig. 4. T.S. of testis in the last week of March showing increase in the number of spermatogonia and a reduction of the interstitial cells. (Iron haematoxylin & eosin stained)

100 μ Fig. 6

Fig. 5. T.S. of testis in the first week of April showing fat in the cells of the seminiferous tubule as well as those of the interstitium. (Sudan Black B stained)

Fig. 6. T.S. of testis 2-3 days prior to the migration showing considerable decrease in the number as well as the size of the interstitial cells. The well developed seminiferous tubules are seen to contain a large number of primary and secondary spermatocytes. (Iron haematoxylin & eosin stained)



50 μ Fig. 7

Fig. 7. A portion of fig. 6 magnified.

February to March:

The testis showed an increased rate of development from February onwards. The increase in the weight of the testis, diameter of the seminiferous tubules and their cell counts as observed from transverse sections can be seen in Table I. Some structural changes in the cells of the seminiferous tubules and those of the interstitium were also observed. The cells in these regions of the testis increased in size as well as in number (Fig. 2, 3, 4) and considerable fat accumulation was also noted.

April:

The increase in fat content upto the first week of April (Fig.5) was followed by a decrease towards the time of migration. The diameter of the seminiferous tubules as well as that of their cells however, increased considerably (Table I). The primary and secondary spermatocytes also appeared in abundance in the tubule (Figs.6, 7). The cells of the interstitium were reduced in number and were compressed by the tubules which were increasing in size (Figs. 6, 7). The blood circulation in the testis was distinctly more. The primary and secondary spermatocytes did not develop any further into spermatids and spermatozoa even till the time the birds migrated at the end of April.

Discussion

In the period October to January during which there is no testicular development in this bird may be regarded as its refractory period (regeneration phase of Marshall, 1959)or preparatory phase of Wolfson, 1960). By photostimulation the testes in most birds of the temperate region were brought to active development while in the regression period (Burger, 1949; Miller, 1954; Farner, 1959). Lofts(1962) observed in an equatorial bird, Quelea quelea that the refractory period is independent of photoperiodic fluctuations. This strongly suggests that the development of the testis in equatorial migrants is not entirely dependent on photostimulation. The Rosy Pastor spends most part of the year in western India which lies in the region of Tropic of Cancer where the difference in day length during the period between December and February, is not considerable. In this bird the development of the testis starting from the month of February cannot be considered as due to photostimulation but due to some other intrinsic or extrinsic factors.

The possible intrinsic factors acting as the stimulus for migration such as the hypothalamic neurosecretion (Chapter 6), secretions of the anterior pituitary (Chapter 7), the thyroid (Chapter 4) and the adrenal (Chapter 9) are discussed in the respective chapters. Side by side with the development of the testis certain changes have been noted in the anterior pituitary and the thyroid. These changes may be regarded as an expression of the intrinsic factors influencing the development of the testis. With the increase in testicular tissue increase in the activity of the cells of the follicle stimulating hormone (FSH) of the anterior pituitary as denoted by the intensity of the staining for PAS-positive materials as well as increase in number and size of these cells towards migration, were noted (Chapter 7). In the refractory period of these birds the cells of the FSH of the anterior pituitary were inactive. Benoit et al.,(1950), Lofts and Marshall (1958), have stated that in the refractory period the testis ceases spermatogenetic productivity due to a seasonal cessation of the gonadotropic output of the pituitary.

Thyroid has also been increasing gradually reaching the peak towards migration (Chapter 4). A gradual increase in thyroid activity has been shown to increase the development of the testis in mammals and birds (Maqsood, 1952, 1954). In the Rosy Pastor also the gradual increase of the thyroid might explain the increase in the testicular activity. A few days prior to migration there was a sudden release of the colloid from the thyroid follicles (Chapter 4). The spectacular release of thyroxin could be attributed to the release of the thyrotropic hormone (TSH) from the anterior pituitary (Chapter 7). The excess release of TSH is known to be antagonistic to the gonadotropic hormone (Maqsood, 1952, 1954; Höhn, 1961). In these circumstances it is to be expected that there could be no further development of the testes. It was indeed so, since the development of the cell component in the testis ceased at this stage having only the primary and secondary spermatocytes, without producing spermatids and spermatozoa. A temporary suspension of testicular activity which is again to be resumed after reaching the breeding grounds, may be considered as a useful adaptive mechanism in migration.

Summary

1. The histological observations on the testis of the migratory starling, Sturnus roseus were made during the months October to April. The weight of the testis, diameter of the seminiferous tubules and cell counts were also recorded.

2. The testes were in regressed condition from October to January. A gradual development of the testis was seen from February upto the end of March. During this period increase in the number of cells of the interstitium and that of the spermatogonia in the tubules was noted. The fat content of these cells was also found to increase gradually. In April the seminiferous tubules showed very rapid development and became completely packed with spermatogonia as well as primary and secondary spermatocytes. The increase in fat in the cells of the interstitium and the tubules reached the peak in the first week of April. Thereafter there was sudden decrease in the number, size and fat content of the interstitial cells until migration.

3. The cyclic changes in testicular development is correlated with the corresponding changes in the thyroid and the FSH of anterior pituitary. It is concluded that the suspension of the spermatocytes to spermatids and spermatozoa is affected by the excess release of thyroxin prior to migration.